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FUNCTIONAL DISEASES OF THE STOMACH.

PART I.

SEA-SICKNESS :

ITS NATURE AND TREATMENT.

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ADVERTISEMENT.

It was my intention to publish a treatise in one volume on the various functional diseases of the stomach, including that of sea-sickness; but up to the present time I have been too much occupied to be able to do more than prepare the part on sea-sickness only.

JOHN CHAPMAN.

44, SOMERSET STREET, PORTMAN SQUARE,
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SECTION I.

INTRODUCTION:

*General Principles of Vaso-Motor Therapeutics.**

THE discovery that the sympathetic nerve causes the contraction and permits the dilatation of bloodvessels, and the establishment of the doctrine that the main force effecting the circulation of the blood is a chemical one—consisting in the attractions exerted, in the case of the pulmonary circulation, between the inspired air and the venous blood, and, in the case of the systemic circulation, between the tissues and the arterial blood,—inaugurated a new era in physiology, and gave promise of one in therapeutics.

No philosophical physician who recognises these two important truths can fail to discern that if the power of stimulating or restraining the generation of nervous force by the sympathetic ganglia be once attained, the power of increasing or decreasing the diameter of the bloodvessels, and consequently the chemical changes which constitute nutrition and decay in each part of the body, will have been attained also. No man has foreseen this great result more clearly than Dr. Brown-Séquard,

* This Section is reprinted, with additions, from *The Lancet* of June 4th, 1864. The phrase *Vaso-motor Therapeutics* fairly expresses the leading feature of the system here indicated; but perhaps the word *Neuropathy* would characterize it equally well, if not better, while it has the advantage in brevity.

who, in one of his lectures delivered at the Royal College of Surgeons in 1858, said:—"I consider that the knowledge of the effects of the paralysis and the irritation of the sympathetic nerve opens a new and most important field in physiology, in pathology, and in therapeutics." But, distinctly as he foresaw and foretold the revolution possible in the science of medicine whenever an adequate controlling power over the sympathetic nerve should be acquired, he had no conception of any such power within reach of the physician.* It is true that in 1863, at the Hospital for the Paralysed and Epileptic, he stated that, in order to overcome the spasmodic contractions of the cerebral arteries constituting the first phase in a fit of epilepsy, he was entertaining the idea of paralysing the cervical sympathetic nerve by dividing it; but though an exceptionally heroic patient might be found willing to undergo such an operation, I apprehend few physicians would be found willing to advise it.

While studying the diseases of the nervous system at the hospital in Queen-square, I became impressed with the conviction that in proportion to the number of patients suffering from paralysis or epilepsy the number of cures was lamentably small (although the institution had the help of one of the most distinguished physicians in Europe), and that, with respect to many forms of

* We know that strychnine increases the capacity of reflex action in the spinal cord, and it is inferred that it does this, in part at least, by increasing the diameter of the bloodvessels, and therefore the nutrition, of that organ. This inference is, however, open to question; and, so far as I am aware, no evidence has yet been tendered that strychnine has the power of inducing the dilatation of bloodvessels in any other part of the body. The medicines chiefly relied upon to lessen the diameter of the bloodvessels are belladonna and ergot of rye: the extent to which these drugs are capable of thus acting is matter of grave uncertainty; indeed, their mode of action is not understood, and if they do increase the force-generating power of the sympathetic ganglia, they do not do so in suchwise as obviously to lessen the circulation in either the viscera or the limbs.

paralysis, and all forms of epilepsy, a hitherto insoluble problem demanded solution before the physician could be permitted to hope for the power of treating those diseases with any considerable success. That problem presented itself to my mind thus:—"By what means can the quantity of blood circulating in the spinal cord, including the medulla oblongata, and in the ganglionic nervous system, be most effectually increased or lessened?" In the latter part of 1862 the idea occurred to me that this problem might be solved by modifying the temperature of the parts in question, and that this could be done by means of cold or heat applied along the centre of the back. During the first half of 1863 I tried the efficacy of this method in numerous cases, and had the satisfaction of finding that the remedial power which had hitherto existed only as an idea occupying my mind day and night for months, was an indubitable reality.

Until the date of my experimental demonstration that the circulation of the blood may be increased by cold applied to the back, it was held that cold thus applied for any considerable length of time was dangerous; and hence, as no one ventured to experiment in this field of alleged peril,* the extent of the remedial power, even so far as the spinal cord alone is concerned, which consists in modifying the temperature of the back, remained unknown. Now, I have proved by numerous experi-

* On the mistaken assumption that cold applied to the back "has a very powerful influence in diminishing both the force and frequency of the heart's action," Dr. Todd expressly warned his pupils thus: "For this reason you must not apply it for too long a time, or over too great an extent of surface; you must watch your patient, and remove and re-apply it as his condition shall indicate." A curious illustration of how one error leads to another is presented in Dr. Fuller's work on "Diseases of the Chest," p. 267. Referring to the treatment of pulmonary hæmorrhage, he says: "My own experience leads me to testify most strongly in favour of repeated dry cupping, aided by the application of ice down the spine, and by the internal administration of full doses of digitalis." Assuming the truth of Dr. Todd's doctrine as to the

ments that cold applied to the back not only exerts a sedative influence (a "depolarizing" influence, according to Dr. Todd) on the spinal cord, but also on those nervous centres which preside over the bloodvessels in all parts of the body. The *modus operandi* of this influence on those centres and its effects may be thus stated:—1st. It partially paralyses them. 2nd. By means of the partial paralysis thus effected it lessens the nervous currents in the vaso-motor nerves emerging from the ganglia or nerve-centres acted upon and distributed to the muscular fibres surrounding the arteries influenced. 3rd. By thus lessening those currents, it lessens the contractile energy of the muscular bands of the arteries to which those currents flow, and by doing so facilitates the dilatation of the arteries themselves. 4th. By thus inducing the condition of facile dilatability in the arteries acted upon, it enables the blood, which flows in the direction of least resistance, to enter them in greater volume and with greater rapidity than before.

The conditions here enumerated are analogous to those first induced in 1851 by Prof. Cl. Bernard when he divided the cervical sympathetic nerve. In those parts of the head to which that nerve is distributed the flow of blood was increased. The effects of this increase, as noted by several different observers,* are very numerous, remark-

effects of ice down the spine, Dr. Fuller's application of it is at once logical and ingenious; but I am prepared to prove that of all agents used as remedies, whether internally or externally, there is none so capable of predisposing to hæmoptysis, if not of actually inducing it, as "the application of ice down the spine." Were Dr. Fuller to depend on it alone, in treating hæmoptysis, instead of combining it with dry cupping and digitalis, he would soon see how dangerously he has been misled. Fortunately, he averts the evil influence of "ice down the spine" by dry cupping and digitalis, and thus one part of the treatment neutralizes the effects of the other. Heat properly applied between the scapulæ will stop hæmoptysis, and will often in a few minutes disperse the pulmonary congestion which usually preludes it.

* Dr. Brown-Séquard has published a list of the "Phenomena observed in

able, and instructive. Assuming the vaso-motor function of the Sympathetic to have been already known, they are what might have been stated *à priori*; and various as they are, they may be all summed up in the words of Dr. Brown-Séquard—"dilatation of bloodvessels, afflux of blood, increase of vital properties." These phenomena, which Prof. Cl. Bernard induced in the head of an animal by section of the cervical Sympathetic, I have induced in the head, thorax, abdomen, pelvis, and four extremities of man by the application of ice to different parts of the back.

If "dilatation of bloodvessels, afflux of blood, increase of vital properties," be thus induced, it follows inevitably, as will be presently shown, that "both the force and frequency of the heart's action" will be proportionably increased also. The opposite doctrine—viz., that the application of ice to the spine lowers the pulse and vital force—is therefore erroneous, and need no longer deter physicians from exercising the great remedial power at their command in the shape of ice when judiciously applied to a part or to the whole of the back, or from making experiments to ascertain what the extent of that power is. Concerning both its nature and extent I have much to say—much in the form of a record of experience, much also by way of suggestion or prediction; meanwhile let the reader clearly distinguish and bear in mind the twofold and widely differing influences which ice applied to the back exerts.

Ice is a direct sedative to the spinal cord, if applied immediately over it: by lessening the amount of blood in it, ice lessens its functional and especially its automatic

the head, on the side of the operation," and of the "Authors who have made the first observation." See his "Lectures on the Physiology and Pathology of the Central Nervous System," p. 140.

or excito-motor power. The therapeutical applications of this fact are numerous and immensely important.

Ice applied over and on each side of the spine is also a direct sedative of those organic nervous centres which preside over the vascular system; but though lessening the amount of blood in them, and consequently their controlling force over the bloodvessels they govern, ice is indirectly an immensely powerful stimulant of the circulation and of the vital processes, and may thus influence all parts of the body except the spinal cord and the sympathetic ganglia themselves.*

Having proved by repeated experiments that cold applied to the back is capable of producing the effects above stated, I next proceeded to realize my idea of the effects of heat applied in the same way. My first experiment of this kind was in the treatment of a case of menorrhagia. The result was decisive, and has since been confirmed by an extensive experience in reference to various parts of the body. Of course, the physiological conditions induced by heat applied to the back are precisely opposite to those already enumerated as induced by cold:—1st. The temperature of the sympathetic ganglia being raised, the flow of blood to them becomes more copious, and consequently their functions become

* As it is probable that the bloodvessels of the spinal cord, in common with those of the rest of the body, are subject to vaso-motor nerves emerging from the Sympathetic, it is reasonable to suppose that the circulation in the cord is subject to two contrary influences when cold or heat is applied along the back. When cold is applied, the one influence is direct and sedative, the other indirect and stimulant; when heat is applied, the one is direct and stimulant, the other indirect and sedative. The direct influence is, however, indubitably far more powerful than the indirect one. It is conceivable, according to the hypothesis here stated, that cold or heat may be applied on each side of the spine at such a distance from it as to ensure that the indirect influence on the bloodvessels of the spinal cord, through the agency of the Sympathetic, shall be greater than the direct influence; but much careful investigation will be needed to determine this possibility.

more energetic than before. 2nd. Their nervous influence passes in fuller and more powerful streams along the nerves emerging from them, and ramifying over the bloodvessels which they control. 3rd. The muscular bands surrounding those vessels are stimulated by this increased nervous afflux to contract with more than their usual force, and so to diminish proportionably the diameter of the vessels themselves. 4th. The diameter of the vessels being thus lessened, the blood flows through them in less volume and with less rapidity than before: indeed, it is probable that, while the nervous ganglia in question are made to emit their maximum of energy, many of the terminal branches of the bloodvessels acted upon become completely closed.

This series of effects caused by heat applied to the back is identical with that induced in the head by galvanizing the cervical Sympathetic. In 1852-3, after Prof. Cl. Bernard had demonstrated the effects which invariably follow the section of that nerve, Dr. Brown-Séquard, Prof. Cl. Bernard, and Dr. Augustus Waller found, independently of each other, that its galvanization is invariably followed by effects exactly opposite to those of its section. These effects, so far as observed, are enumerated by Dr. Brown-Séquard, who sums them up under the three heads—"contraction of bloodvessels, diminution of blood, decrease of vital properties." These effects, induced in the head of an animal by galvanizing the severed end of the upper part of the cervical Sympathetic, I have induced in the head, chest, abdomen, pelvis, and extremities of man by heat applied to the back. The therapeutic power conferred by this discovery, and which I have already verified, is, I believe, quite as great as that previously described—namely, the power of cold applied to different segments of the back.

The physician who does not merely grope his way, but who, with the mind's eye, looks far ahead of his actual position, will speedily descry a large proportion of the most important consequences of his ability to modify the circulation of the blood in the different regions of the body as now explained. The employment of this new remedial agency in the treatment of any particular disease will involve a special discussion of the proximate cause of that disease, and of the condition of the vascular system in the part affected. In this preliminary and general statement such discussions are of course impossible. In my *brochure* on the "Functional Diseases of Women" I have given a number of cases illustrative of a new mode of treating them through the agency of the nervous system by means of cold and heat applied to the back; and in my private practice I have obtained proofs, which I hope soon to publish, that the majority of diseases may be advantageously treated in like manner. I limit myself here to a consideration of the innovation in the practice of medicine generally which the acquisition of the power of increasing or decreasing the amount of blood in the nervous centres along the back will inevitably produce.

There is an exceedingly important group of abnormal affections of the spinal cord in which the amount of blood circulating in it and in its membranes exceeds that of health, and in which, according to the degree of excess, the condition of the organ ranges between the limits of acute inflammation and merely undue functional activity. The number of abnormal phenomena resulting from the various degrees of this vascular excess is surprisingly great; while the power of any known medicines to reduce that excess to the normal standard is deplorably small. Now for all forms of disease produced by the cause in

question, the least injurious, most scientific, and incomparably most efficacious remedy is cold applied along the whole or some part of the spine—cold varying in intensity, and applied during various lengths of time, according to the nature of the disease under treatment. By this method the bloodvessels of the cord and of its sheath may be contracted, and by thus lessening the amount of blood in them the diseases dependent on vascular excess may be most effectually combated.

The opposite condition, or anæmia of the spinal cord, is comparatively rare ; and its symptoms, except in certain forms of paralysis, are obscure and but little understood. In so far, however, as the physician can assure himself that the proximate cause of any given malady—paraplegia, for example—consists in a deficiency of blood in the cord, he may hope by the application of heat alone,* or by heat and cold alternately, or by cold and vigorous friction (which evolves heat), to the spine, to confer more benefit than is derivable from medicines.

The vaso-motor nervous centres are also deprived of a portion of their accustomed amount of blood, and therefore, like the spinal cord, are subject to a sedative influence, by the application of cold to the back ; but, as already stated, the resulting phenomena in the parts the bloodvessels of which are controlled by the particular centres acted on are those of stimulation : the bloodvessels dilate, more blood flows into them, the chemical changes constituting nutrition and decay, and accompanied by the evolution of heat, are more rapid than before, and, as a general rule, the functional capacity, as well as the temperature of the part in question, is increased. These effects of admitting more than the

* In many cases the application of heat alone is injudicious : the reason of this will be explained when I shall advert to the treatment of paralysis.

wonted supply of blood to any given part of the body become, in their turn, a cause of increase of the general circulation, or of "the force and frequency of the heart's action."

It is difficult to see at first sight how this comes to pass; but such is the fact. If, however, as I have stated elsewhere, before the ice is used, the pulse is abnormally high, owing to nervous excitement, or irritation caused by disease, it will fall to nearly its normal standard after ice has been used for a short time; having so far descended, it will be sustained there as long as ice is used, provided the patient be well fed. But, if the frequency of the heart's action be below the normal standard of any given patient before ice is applied, it will steadily increase under the use of ice until it exceeds that standard, and, if the patient be well fed, and his general health carefully attended to, the increase will be maintained throughout the period of treatment.

If we confine ourselves to the doctrine of Harvey as an adequate explanation of the circulation of the blood, we shall indeed find it exceedingly difficult, if not impossible, to account for the facts just stated. The conviction, however, has been deepening of late years that a variety of phenomena observable even in man and the higher animals—phenomena in the production of which the movement of the blood is chiefly concerned—are not accounted for by the hypothesis of Harvey; and, in proportion as we descend the animal scale, this hypothesis becomes more and more inadequate as an explanation of the movement of the blood. Blushing, sudden paleness of the face, flushings and chilliness of the whole body frequently occur without any corresponding disturbance or modification of the heart's action. The enlargement of the mammæ, the turgidity of the nipples

during suckling, the sudden suffusions of the reproductive organs, menstruation, the supersanguineous condition of the gums during dentition, the steady movement of the blood in the capillaries, the circulation through the liver without the intervention of any propulsive force, the circulation in monsters born without a heart, the fact that after death the arteries are usually found empty, and, pre-eminently, the local afflux of blood in inflammation, cannot be accounted for on the hypothesis that the heart is the sole mover of the blood. Attention having once been fully directed to these and many other facts of like significance observable in man and the mammalia generally, physiologists have not been slow to discover a whole series of facts in different departments of the animal and vegetable kingdoms which, while tending to discredit the generally-received doctrine concerning the circulation of the blood, greatly contribute to elucidate, if not fully to explain, the phenomena above mentioned and others of a similar nature which the heart is obviously incapable of producing. In many vegetable cells movement of the contained fluid, seemingly of automatic character, occurs; the circulation of the sap in plants takes place without the intervention of any central force or propulsive organ; in the lowest forms of the protozoa, in which no contractile vesicle is discernible, a rapid movement of granules is nevertheless distinctly visible; and, overleaping the intervening grades of animals in which the circulation is more or less exclusively carried on without the aid of a heart, we see in fishes a very remarkable example of the extent to which the blood circulates independently of any propulsive force. The single heart of these creatures is employed only in pumping the blood to the gills; having passed through them, it circulates through the

entire system and returns to the heart, no pressure from behind being exerted upon it. In presence of these facts the question arises, What is the force which moves the fluid in the several instances adduced?

Stated in its simplest form, the answer is that the force in question is a chemical one, and consists in the attraction between the cell or tissue requiring to be nourished or transformed and the elements provided to minister to this change. In the case of the higher organisms possessing a heart its function is purely ministerial: it serves, in fishes, to propel the blood to the gills only; in mammals it not only propels it to the analogue of the gills—namely, the lungs—but also to the entrance of the systemic capillaries. In 1836 Professor Alison of Edinburgh published his reasons for believing that a great auxiliary force is exerted in the capillary vessels: this doctrine has been developed and illustrated by Dr. Draper of New York, in his admirable work on Physiology, and is adopted by Dr. Carpenter. The mode of attraction by which the “auxiliary force is exerted in the capillary vessels” is thus stated by Dr. Draper. Speaking of the blood in the systemic capillaries, he says:—“The oxidizing arterial blood has a high affinity for those portions [of tissue] that have become wasted: it effects their disintegration, and then its affinity is lost. The various tissues require repair; they have an affinity for one or other of the constituents of the blood; they take the material they need and their affinity is satisfied; or secreting cells originate a drain upon the blood, and the moment they have removed from it the substance to be secreted, they have no longer any relation with it. So processes of oxidation, and processes of nutrition, and processes of secretion, all conspire to draw the

current onward from the arteries, and to push it out towards the veins; and though these processes may present themselves in many various aspects, they are all modifications of the same simple physical principle." In the pulmonary capillaries the same physical principle comes again into action. "The venous blood has a high affinity for the oxygen of the air, an affinity which is satisfied as soon as the blood presents itself in the cells of the lungs. Arterialization being accomplished, the portions to be changed exert a pressure on those that have changed, and the blood, moving forward in the pulmonary veins, reaches the left auricle of the heart."

This doctrine of the nature of the forces effecting the circulation of the blood enables us to explain how ice, applied to the back, increases the force and frequency of the heart's action. The terminal branches of the arteries having been allowed to dilate in the manner already explained, an increased quantity of blood is brought in contact with the tissues, between which and itself a chemical attraction exists. The amount of attractive force exerted thus becomes larger than before, and therefore the amount of chemical change also. The whole of the transformative processes are proportionately intensified, and the vitality of the part in like manner heightened.

Increased rapidity of textural transformation involves increased demands on the nutritious and vitalizing elements of the blood, which is consequently drawn to the part in still more copious streams; and passes through its capillaries more swiftly than before; while the greater heat evolved reacts as a stimulant and favouring condition of still more rapid chemical change, and becomes diffused to a certain extent through the blood of the whole body. The heart, sharing in the general stimu-

lation, becomes more active, and, responding to the heightened attraction of the textural elements for blood, sends it to them with increased rapidity, fresh supplies being forced upon it with equal speed by the pulmonary capillaries, which are called upon to do their decarbonizing and oxygenating work more quickly than before. In this group of phenomena is presented a *faint* likeness of what occurs when slight inflammatory fever accompanies and results from the inflammation of a fractured limb. Now, as in the limb the reparative process is hastened by the increase of circulation through it, provided the sanguineous afflux does not exceed certain limits, so when the vitality and functions of any part of the body are impaired, its regeneration or invigoration is most likely to be effected in the majority of cases by increasing the circulation in it by means of cold applied to the appropriate segment of the back. When I shall hereafter discuss and illustrate the treatment of special diseases, according to the method here explained, I shall give indubitable proofs of the truth of this statement.

Heat acting on the vaso-motor nerve-centres produces physiological effects directly upon them and indirectly on the bloodvessels which they govern of an exactly opposite character to those just described. The nerve-centres, acquiring a maximum supply of blood, compel the relaxed bloodvessels related to them to contract, and thus, shutting off a large proportion of the blood which would otherwise have flowed through them, lessen the rapidity of the vital processes in the structures amid which they ramify. This diminution of textural transformation, of nutrition and decay, is accompanied by a corresponding diminution in the amount of heat evolved, and in the functional activity of the structures in question. The sedative influence which has thus been exerted locally

becomes diffused generally throughout the system, often to an appreciable extent, the blood passing through the part acted on being less than before; and in consequence of the fall in the local temperature, the chemical changes to which even this lessened quantity ministers being also lessened in intensity, the temperature of the whole blood becomes proportionately lowered, and therefore proportionately less stimulant in all parts of the body. Moreover, the local vitality or textural change, and, therefore, the attraction between the structures acted on and the nutritious and vitalizing elements of the blood being lessened, the blood is moved through the capillaries more slowly, and is drawn to them less abundantly and less swiftly, than before; while the demands on the heart being to a like extent lowered, and the pulmonary capillaries forcing upon it less supplies of newly oxygenated blood than before, it acts with proportionately less energy and rapidity. In this assemblage of phenomena is presented an *exact likeness* of what occurs in a large number of women when uterine or ovarian irritation is propagated to, and reflected from, those nervous centres which preside over the bloodvessels of the lower extremities. The vessels contract, the limbs become cold, their vitality is lowered, the blood returns from them colder than from any other part of the body, and diffusing its sedative or deadening influence throughout the entire blood, lowers the whole constitutional energy, together with the force and frequency of the heart's action. Now, as this condition may be induced in each or all parts of the body by the application of heat to the back, I venture to affirm, as I have already done elsewhere, that this agency "will be found to be at once a delightful, wholly beneficent, and effective subduer of inflammation," and that for all classes of congestion, plethora, and undue

vascular activity, it is at once the most powerful and manageable remedy at the command of the physician. It is almost needless for me to intimate how large is the number of diseases the proximate cause of which consists in some one of the numerous degrees of hyperæmia, and that if heat applied to the appropriate segments of the back acts as here alleged, how great is the remedial power which its use, as indicated, confers.

In the preface to my pamphlet already mentioned, I said, "It is probable that the more the diseases and the functional derangements of animals, having a nervous system, are investigated, the more they will be found to originate primarily in altered conditions of that system." I shall hereafter justify this remark by ample evidence. Meanwhile I may observe that the proximate cause of most of the abnormal affections of the brain which are not due to structural injury consists in abnormal states of the cervical and upper dorsal ganglia of the sympathetic nerve; that diseases of the lungs are to a large extent, at least, referable in like manner to abnormal states of the dorsal ganglia; that impaired functions of the stomach and alimentary canal chiefly arise in abnormal states of the lower dorsal and upper lumbar ganglia, and of the corresponding segments of the spinal cord; that the functional diseases of the generative organs, both male and female, as well as those of the vascular system in the lower extremities, are essentially unhealthy modifications of the lumbar and sacral ganglia, and of the lower segments of the spinal cord; and finally, that I have experimental proof that a remedial influence, capable of being restricted to special regions of the body, may be exerted over all the viscera by means of cold or heat appropriately applied to the several nervous centres by which their bloodvessels are controlled.

SECTION II.

*Sea-Sickness : its Nature and Treatment.**

THE *proximate* cause of the remarkable and often terrible malady—sea-sickness, has excited endless discussion, but has still remained involved in great obscurity. Several sagacious conjectures have, however, been hazarded concerning its nature, some of them, as I believe myself able to prove, coming very near the truth. The doctrine of the excito-motor or reflex functions of the spinal cord is a guide to the whole physiology of sickness, and following it, I was led to predict how to prevent, arrest, or control, not only sea-sickness, but, also, how to remedy or palliate every kind of sickness, whatever may be its *primary* cause.

I hold that the *proximate* cause of sea-sickness consists in an undue amount of blood in the nervous centres along the back, and especially in those segments of the spinal cord related to the stomach and the muscles concerned in vomiting. This condition is induced by the movement of the vessel, in, I believe, three ways :—1st, through the brain ; 2nd, through the ligaments of the spinal cord ; 3rd, through the abdominal and pelvic viscera.

If, by one or several causes, the amount of blood circulating in the spinal cord be increased considerably beyond the normal amount, all the nerves emanating from it partake of the increased activity of the cord itself, and convey from the centre to the periphery of the nervous system an abnormally large number of exciting

* This Section is reprinted from *The Medical Times and Gazette* of September 3rd and 10th, 1864.

impulses. Those parts of the body which are subject to the will—the purely voluntary muscles—resist these impulses most easily; and only in extreme cases, therefore, are their ordinary functions deranged; but the involuntary or purely organic functions, being unsustained by cerebral influence under the direction of a dominating will, have their usually regular and tranquil life easily disturbed and thrown into confusion by the unwonted number of exciting impulses transmitted to them from the preternaturally excited spinal cord.

CEREBRAL MOVEMENTS A SOURCE OF SEA-SICKNESS.

In those cases in which the brain is the principal or first seat of disturbance, it is probable that this organ is protected from concussion against the walls, and especially against the base, of the skull by a less than the normal amount of the cerebro-spinal fluid; or that the brain in such cases is so peculiarly susceptible to shocks as to become abnormally excited by concussions too slight to be felt or to produce inconvenience in really healthy persons. The cerebral circulation may also be especially liable to derangement—the arteries unduly contracting or dilating in response to influences which would exert no sensible effect in the other classes of sufferers from seasickness. So great is the difference in the amount of blood circulating in the brain at different times, that it swells up and contracts again to an astonishing extent, in correspondence with its varying degrees of activity or of repose. Observations of the living brain in man and animals, in cases where portions of the skull have been removed, prove that the cerebral expansion during wakefulness, and still more during mental excitement, is remarkably great—vessels previously invisible suddenly

swelling to appreciable diameters, and those already discernible becoming notably larger; and conversely, that during tranquillity, and still more during dreamless sleep, the cerebral contraction is simultaneously great, so that the brain occupies a much less space than before. If the brain can thus enlarge and diminish within its bony case in proportion to the amount of blood circulating in it, it is evidently capable of movement by violent impulses from without to an extent sufficient to induce great cerebral irritation, and at the same time to contribute to the motion of the spinal cord, and thus to irritate it through the jerks on the ligamentum denticulatum in the manner about to be suggested. When a person is in an upright position in a pitching vessel, the brain, being a soft substance, alters its form with every rise and fall of the ship. At the moment when the upward movement is arrested the brain continues to tend in the same direction, and as the downward movement begins presses towards the roof of the skull; and then again, when the downward movement is arrested, the brain continues, as before, to tend in the same direction, and as the upward movement re-commences, presses towards the base of the skull. In this manner the brain tends to expand in its lateral diameter, and to contract or become slightly flattened in its vertical one, and therefore to pull, in some slight degree, the cord upwards and again to press it downwards, thus acting as a co-operative cause of the vertical movement of the cord within its fibrous sheath.

It is a notable fact that in many sufferers from seasickness headache peculiarly intense is one of the most striking symptoms. In these cases of undue cerebral sensitiveness exciting impressions are transmitted from the brain to the medulla oblongata, and thence forward

to the whole spinal cord; these impressions, acting as irritants, increase the flow of blood to the whole spinal axis, and, consequently, its functional activity; the nerves emanating from it, and conveying its impulses, directly or indirectly, to the stomach and other abdominal viscera, excite them to preternatural action; when that action exceeds certain limits, the thoracic and abdominal muscles also become active, either simultaneously and directly, or secondarily and indirectly—through the medium of impressions propagated from the excited stomach to the spinal cord, and from it reflected to them; thus sea-sickness, in its various grades of nausea, retching, vomiting, may originate in cerebral disturbance, the stomach being unduly excited, not, perhaps, through the intervention of the spinal cord and sympathetic ganglia only, as I believe it is in the sickness of pregnancy, but also through the medulla oblongata and its efferent pneumogastric nerves.

SPINAL MOVEMENTS A SOURCE OF SEA-SICKNESS.

As the spinal cord is suspended in a fibrous tube by means of a series of lateral ligaments, and is surrounded by water—the cerebro-spinal fluid—by which it is saved from concussion, it is probable that each time the body, when in a standing or sitting posture, is rapidly raised or depressed by the alternate rise and fall of the vessel, there is a slight jerk on each of the ligaments holding the spinal cord in its place. If we suppose a person to be sitting in the middle of a compartment of a railway carriage, and to be tied in his place by four cords passing from him to the four corners of the compartment, and then that the carriage be suddenly moved, the tendency of the body to remain stationary will cause a jerk on two of the cords, the jerk being felt, of course, at the points where the cords are tied on the person. On the same

principle and in the same manner the movements of the vessel cause jerks on the inner sheath of the spinal cord along the line of origin of the spinal ligaments, called collectively the *ligamentum denticulatum*. These jerks produce irritation, and consequent afflux of blood, and as in cases when the outer cerebral membrane, the dura mater, is inflamed or irritated, the abnormal condition affects the brain also, so, *à fortiori*, if the inner sheath of the spinal cord—the pia mater, with which the ligamentum denticulatum is homogeneous—becomes the seat of undue vascularity, the spinal cord itself will be likewise affected. It has already been suggested that the movement of the brain itself and its consequent slight changes of form are likely to cause some alternate tension and slackening of the spinal ligaments; but as the substance of the cord is soft, like that of the brain, it is liable throughout nearly its whole length to a certain amount of derangement by the alternate rise and fall of the vessel, on the same principle and in the same manner as the brain itself, even though each end of it were immovably fixed; and thus it is difficult to avoid the conviction that the cord is always subject to slight jerks along the line of origin of the ligamentum denticulatum, partly in consequence of its connexion with the brain, moving as described, and partly in consequence of the movements directly imparted to it by the pitching vessel. Violent pitching movements may thus increase the circulation of the whole cord in persons who maintain an upright position, and indirectly through it the circulation of the proximate sympathetic nervous centres; it is easily conceivable that in this manner those segments of the cord related to the stomach (directly or indirectly) and to the muscles concerned in vomiting will transmit their impulses to these organs in such an abnormal degree as to induce sickness in all its grades. Assuming that sea-sickness is some-

times induced in this way, it is probable that it is so in those persons in whom the spinal cord, as well as the dorsal ganglia of the sympathetic, is already in an abnormal or peculiarly sensitive condition. In persons who believe themselves healthy there is a remarkable difference in the degrees of tenderness observable when pressure is made along the different parts of the spine; and perhaps further investigation will prove that persons in whom preternatural tenderness is detected are peculiarly liable to sea-sickness.

VISCERAL MOVEMENTS A SOURCE OF SEA-SICKNESS.

The third process by which an abnormal amount of blood is induced in the nervous centres along the back consists in the excessive movements of the viscera within the abdominal and pelvic cavities; indeed, the weight of the heart is such as to justify the belief that this part of the contents of the thoracic cavity is also impelled at least upwards and downwards with preternatural force by the motion of the ship, and in this way helps to disturb the regular action of the diaphragm to which it is attached, and which, in consequence of the excessive movements of the abdominal viscera, is subject to more than the normal pressure which they make upon it. As the body is moved upwards and downwards and from side to side with the vessel, the solid and hollow viscera are more or less violently shaken and brought into concussion with each other. In proportion to the amount of contents of the hollow viscera will be the impetus of their movements, and the consequent force of the shocks against each other and the abdominal walls which they experience.* These

* A gentleman has recently informed me that his wife when at sea during pregnancy suffers much more from sea-sickness than she does when at sea at other times. This increase may be due in part to the cause suggested in the text, but it is doubtless also due to the physiological excitation transmitted from the enlarging womb to the nervous centres which preside over it.

movements and shocks, and the irritation caused by the continually changing positions of the contents of the hollow viscera, produce an abundance of abnormal impressions upon the nerves distributed to the various organs; these impressions are conveyed through the medium of the complex visceral nerves and the sympathetic ganglia to the spinal cord and possibly to the medulla oblongata, which they influence in the manner already described, thus inducing an excessive reflex action of those organs, and hence the transmission of a preternatural amount of motor impulses to the stomach and bowels, and indeed to all the viscera, as well as to the thoracic and abdominal muscles. Sea-sickness and the diarrhœa which not unfrequently accompanies it are in this manner easily accounted for—so easily, in fact, that the process last described will probably be held by many pathologists to be the chief, if not the sole proximate cause of the malady. The fact that it is induced in this way accounts for the partial relief which sufferers sometimes obtain by the application of tight bandages round the abdomen, as they obviously lessen the visceral movements. Assuming that the several movements of the brain, the spinal cord, and the viscera contribute to cause sea-sickness in the manner now explained, it is easy to understand why it is that persons are most liable to become sick when in an upright position, seeing that that position permits of a more extensive movement of the brain, of the spinal cord, and of the viscera within the abdominal cavity, than is possible when the patient is lying down.

Those of my readers who regard the pneumogastric nerves as the sole source of motor impulses to the stomach will probably object to the theory of sea-sickness last given, that there is no anatomical evidence of the relationship which I have alleged to exist between the spinal cord

and stomach, together with the bowels ; that, with the exception of the par vagum, the nerves distributed to those organs are derived from the ganglia of the Sympathetic, and that no spinal nerves are found to ramify upon them ; and that therefore the idea of afferent nerves conveying impressions from the stomach and bowels to the spinal cord, and of efferent nerves conveying motor impulses from the cord to the stomach and intestines, is a pure assumption. It may be as well to remind such objectors that many facts of animal structure which the anatomist has failed to discover have been revealed to the physiologist ; that numerous vivi-sectional experiments by various investigators go far to establish the relation which I have assumed to exist between the spinal cord and alimentary canal ; and that my own therapeutical experiments, as I shall hereafter show, confirm their conclusions in a very remarkable and decisive manner. Moreover, it is well known that the communicating branches between the spinal cord and the ganglia of the Sympathetic consist of fibres from the cord to those ganglia, as well as of fibres from the ganglia to the cord. Such being the case, we are enabled to understand how these spinal fibres, blending with the sympathetic fibres, may enter into the complex structure of those nervous centres presiding over the functions of the abdominal viscera, although not traceable and demonstrable by the anatomist. And as physiological evidence, derived from dividing in the living animal the communicating branches between the two nervous systems, and observing the results, as well as the evidence I am about to tender, proves that the stomach and bowels may be acted upon through the spinal cord without the intervention of the pneumogastric nerves, we are, indeed, forced to the conclusion that the lines of communication along which the

nervous influence passes must be as follow :—Impressions made on the stomach, and having reference to its functions, are carried by the fibres converging from that organ to the solar plexus, are thence transmitted up the splanchnic nerves to the thoracic ganglia on each side of the spinal cord, and from thence are continued onwards, through the *rami communicantes*, to the cord itself; coming to the cord with preternatural rapidity and energy, they irritate it unduly, increase the quantity of blood in it, and thus induce in it a condition of excessive excitability; its functional power becoming greatly intensified, it reflects, in the form of motor impulses, on the stomach and other co-ordinated organs the impressions made upon it. The impulses transmitted to the stomach itself pass along the same line as the impressions from it, only in the reverse direction—viz., from the cord to the thoracic ganglia, thence by the splanchnic nerves to the solar plexus, and through it to the stomach; but the muscles which co-operate in vomiting receive their mandates of course through the more direct line of the spinal nerves themselves. The bowels tell of the disturbances to which they are subject to the superior and inferior mesenteric plexuses, these transmit the complaint to the vertebral ganglia of the Sympathetic, and they forward it, along the *rami communicantes*, to the spinal cord, which, if thus excited to a considerable degree, sends unusually energetic motor impulses in the reverse direction to the circular muscles along the complaining organs; hence these muscles contract with excessive vigour, and, co-operating with the preternaturally active mucous membrane and other secreting organs along the alimentary canal, induce diarrhoea.

The physiological light thrown upon the relation between the nervous centres along the back and the

stomach and bowels by the application of cold and heat to the spinal region is indeed great, and for therapeutical purposes not less important. I can state from experience that a large proportion of cases of chronic constipation and at least certain forms of diarrhœa can be remedied by modifying the temperature of the back. The subject is, however, more complex than it seems at first sight, and cannot be discussed here *in extenso*; but I may just say that, for good physiological reasons, ice to the back is capable both of overcoming constipation and stopping diarrhœa, and that while heat, which applied to healthy persons tends to impede the functions of the bowels, and which in some cases would restrain diarrhœa, would in other cases—as, for instance, when it accompanies sea-sickness—contribute to its continuance. Moreover, I have reason to believe it probable that the proximate cause of the diarrhœa so common everywhere in hot weather is the same as the proximate cause of the diarrhœa which sometimes accompanies sea-sickness—viz., an undue amount of blood in the mesenteric plexuses and in certain nervous centres along the back. In the one case the ultimate cause of this preternatural sanguineous afflux is the motion of the ship; in the other it is, if I am right, the heat of the sun which raises the temperature of the back. I therefore conjecture that summer diarrhœa may be speedily cured by the application of ice along the lower dorsal and the lumbar region, and should be very glad if physicians having the treatment of such cases would test the value of my suggestion. Moreover, I have strong reasons for believing that the proximate cause of cholera is identical in nature with that of summer diarrhœa, that it differs from it only in the degree of suddenness of its attack and in the

intensity of its action, and that it may be both averted and cured by ice applied along the back. It seems to me likely that, having reference to its cause, cholera may be at once briefly and truly described as “a sun-stroke along the back.”* I shall before long give my reasons for this opinion.

What may be the relative amounts of the several shares contributed by the three chief processes now described in causing that preternatural afflux of blood in the spinal cord on which sea-sickness depends, is a question extremely difficult, and probably impossible, to determine. There can be no doubt, however, I apprehend, but that in one person the brain is primarily responsible; in another, the spinal cord; in a third, the abdominal viscera; although each is always concurrent in some degree, and all ultimately produce the same result; and that, until the irritation of one or all the kinds described be continued sufficiently long to produce a preternaturally large amount of blood in those segments of the spinal cord related to the stomach, vomiting is impossible. An interesting confirmation of the doctrine here expounded consists in the fact that sickness may be induced by heat applied to the back. It is well known that many persons cannot stand with the back to the fire without feeling nausea. In some cases of paralysis in which I have ordered friction to the spine, the friction—by evolving heat, I presume—caused sickness, and there-

* *Heat-stroke* would perhaps be more correct, because the abnormally large afflux of blood presumed to have been induced in the sympathetic nervous centres may not be necessarily caused by the direct rays of the sun, but by the *general* rise of temperature due to the sun's heat. Indeed, if we are justified in using the term *pulmonary apoplexy*, we shall be equally justified, supposing the conjecture expressed in the text be well founded, in designating cholera as *apoplexy of the Sympathetic*.

fore could not be persisted in; and in a case of pulmonary hæmorrhage, in which, as I am in the habit of doing in other cases, I prescribed a double column of heat along the dorsal region, the remedy cannot be adequately used with impunity because, though it stops the hæmorrhage and accompanying pulmonary congestion, it invariably induces sickness. If a short double column of heat be applied to the cervical region only of this patient he becomes sick.*

Besides the phenomena of sea-sickness already adverted to, there are others which, though arresting the observer's attention less forcibly, and though less distressing, are not less interesting to the physiologist and physician—viz., the deadly pallor, the cold sweat, physical weakness, headache, and mental prostration and indifference, which in degrees varying from a condition of mere *malaise* to one of such vital depression as to imperil life itself, form a part of the malady. The pallor, coldness of the surface, and loss of strength, both physical and mental, are all expressions of one and the same

* It is right to observe that this patient has been peculiarly liable to sickness since infancy. His experience is a remarkable confirmation of the truth of the therapeutical doctrines which I have announced, and a not less remarkable, but happily rare, illustration of the difficulty of applying those doctrines in certain cases. If, in order to stop his sickness, cold be applied to his spine, even in the lumbar region, and for a short time only, it induces unpleasant sensations in the chest, and would no doubt soon cause hæmorrhage; while conversely, as already said, if in order to stop pulmonary hæmorrhage heat be applied, he immediately becomes sick. Notwithstanding the sickness, however, he says he shall still use the hot-water bag when either attacked or threatened with spitting of blood. He volunteers an interesting observation concerning the sickness induced in him by the hot-water bag. He says that, whereas when sick spontaneously the sickness is sometimes accompanied with considerable muscular effort, and is always followed by a headache, the sickness caused by the hot-water bag is always without muscular effort, and is never followed by headache. Indeed, if he has a headache at the time of applying the heat, the heat takes it away.

fact, and denote that an inadequate supply of blood is passing through the capillaries all over the body. This diminution and partial arrest of the peripheral circulation involve impairment of the nourishing and oxygenating processes throughout the body; and as animal heat is a result of the chemical changes constituting a chief part of those processes, the temperature necessarily falls when their activity is lessened. The skin as the blood retires from it becomes pallid, the muscles supplied less copiously than before become feeble, and the brain having its sanguineous supplies so far cut off that the forehead generally becomes strikingly cold, is rendered incapable of either vigorous thought or feeling, and, in extreme cases, patients evince utter indifference, both intellectual and emotional, respecting persons and events around them.

Now, if, as alleged, these phenomena are due to a diminution of the blood-currents in the small arteries, and in the capillaries in nearly all parts of the body, the problem for solution is—How is this diminution produced? It is through the agency of the sympathetic nervous system, the orderly action of which is deranged by the ship's movements in the manner now to be described.

As the cerebro-spinal nervous centres are the organs of those excito-motor or reflex functions chiefly concerned in carrying on the relations of the organism with the outer world, so the sympathetic or ganglionic nervous centres are the organs of those excito-motor or reflex functions chiefly concerned in carrying on all those operations which minister to the life, growth, and renovation of the organism itself, and by which its several parts are supplied with material for the elaboration of their respective contributions to the totality constituting

the living being. The most important office of the sympathetic nervous system is that of presiding over and controlling the circulation of the blood: afferent and efferent "organic" nerves ramifying over the arteries, as ivy round a tree, and connected centrally with the sympathetic ganglia, are the media by which the circulatory is subordinated to the nervous system. As the sensory or afferent nerve-fibres of the cerebro-spinal system, which pass from the viscera, convey their impressions to the spinal cord, and in cases of sea-sickness produce the physiological conditions already described, so the afferent nerves of the sympathetic system, receiving impressions in unusual numbers and of unusual intensity from the brain and abdominal viscera, convey them to the ganglionic nervous centres, which reflect them through the ganglionic efferent nerves in the form of impulses or orders transmitted to the arteries, and producing their contraction. Hence the nerves fulfilling these offices are called *vaso-motor* nerves. In order to understand the part they play in sea-sickness, it is necessary to bear in mind that when an impression has been made upon the afferent nerves of an artery, that impression will not necessarily cause a motor impulse to be reflected to that artery, at least not to that alone, but may cause the contraction of arteries far away from it: for example, impressions, as of cold, made on one limb will be reflected on the opposite limb, thus inducing its arteries to contract also; impressions made on the uterine nerves will cause contractions of the arteries of the lower extremities, and *vice versa*; again, abnormal impressions transmitted from the uterine nerves may be reflected on to the bowels and cause constipation. It may therefore be stated as a general truth capable of a wide application, that the limbs of the nervous arcs constituted by the

centripetal and centrifugal nerves, and intervening central ganglia of the sympathetic nervous system, are often very widely spread, and thus, indeed, justify the name "sympathetic," by which that system is mostly designated. Moreover, as all the ganglia of the sympathetic system are intimately connected by inter-communicating fibres, a particular condition of hyperæmia or anæmia induced in one is soon propagated to those in immediate relation with it, and indirectly through them, though in lessened intensity, to those at successively increasing distances from it. A knowledge of these facts will greatly facilitate the understanding of the causal relation of phenomena of sea-sickness now in question.

A ship's motions cause in the persons on board movements of the brain and of the contents of the abdomen and pelvis, as already explained. The abnormal impressions made on the various organs by these movements, and by the various shocks to which they are severally and in varying degrees subject, are received not only by the sensory nerves, as already explained, but also upon the afferent vasic nerves of each organ subject to disturbance. These vasic nerves continue the impressions to the ganglia, and produce there such preternatural activity or irritation as to cause an unusual afflux of blood in them; their functional energy is therefore proportionally increased, and, consequently, they transmit their motor influence in unusually full and rapid streams to all the blood-vessels to which they are related. The muscular coats of these vessels thus stimulated contract; a large proportion of the blood previously circulating in the parts to which the vessels in question are distributed is shut off, and hence the diminution of the capillary circulation, and of all those processes involving nutrition, oxygenation, textural transformation, and the evolution

of heat, on which the continuance of healthy vigorous life depends.

The intimate relation between the bowels and the skin is very remarkable, and has long been the subject of special observation. It is painfully illustrated in cases of those extensive burns which cause death. The amount of injury sustained by the skin itself often extends over so limited an area as to present no adequate reason why death should ensue, and, indeed, is proved not to be its proximate cause—the post-mortem examination revealing internal inflammation or disease either of the brain or of the thoracic or abdominal viscera, which really destroyed the patient. The alimentary canal is peculiarly liable to be thus affected. In such cases the vehemently excited nerves distributed over the injured skin transmit their preternaturally intense impressions to the nervous centres into which they converge, and these, thus unduly excited, reflect them not only to the skin, but in various other directions, and especially on the mucous membrane of the bowels.* It will be readily understood that, if such is the intimate relation between the bowels and the skin, impressions made on any part of the alimentary canal may be reflected from it through the vaso-motor nerves ramifying over the arteries of the skin, thus causing their contraction, diminishing the amount of blood in them and the transformative processes depending on its presence, and consequently the heat of the

* I venture to predict that the lives of many persons imperilled by burns, in the manner described in the text, will hereafter be saved by the arrest of the excessive reflex activity of the nervous centres along the back by means of ice. I have not yet had an opportunity of testing this method in respect to burns, and therefore commend it especially to those physicians who are in the neighbourhood of ironworks and other factories where burns are frequent. If experience shall confirm the accuracy of this prediction, the first physician who shall verify it will contribute to introduce a method of treatment which will greatly alleviate human suffering.

whole surface of the body. The remarkable pallor so frequent in sea-sickness is, of course, only a part of this result. The muscles, having their capillary circulation diminished in the same manner, have their functional power, of course, correspondingly enfeebled. The contraction of the cerebral arteries may be partly induced by motor impulses, which had their origin in impressions conveyed from the viscera to the thoracic ganglia, and producing irritations there which are propagated upwards through the cervical ganglia in the manner already explained; but it is probable that those contractions are chiefly due to irritating impressions made on the afferent nerves of the cerebral arteries and originating in cerebral disturbances caused by the ship's movements. Whatever may be the primary source of the motor impulses causing the contractions of these arteries the pathological result is the same, viz., diminution of the cerebral circulation, impaired cerebral nutrition and function, and that remarkable form of headache resulting from a deficient supply of blood and distinguished by an especial coldness of the forehead. This condition of the cerebral circulation fully accounts for that extreme mental prostration and indifference to all surrounding objects which is such a remarkable feature in cases of extreme sea-sickness. In some cases, however, the cerebral circulation is not thus affected, and usually during the act of vomiting the amount of blood in the head and face is temporarily increased by muscular pressure on the jugular veins and by the disturbance of respiration.

There is one phenomenon of sea-sickness, as indeed of nearly all sickness, viz., profuse perspiration, which I am not able satisfactorily to account for: the physiology of sweating still remains in obscurity. We know little of the *modus operandi* of its production, and less how

effectually to restrain it. It seems at first sight reasonable to suppose that when the skin is most abundantly suffused with blood, perspiration would be most profuse ; and, indeed, the influence of external heat, as that of the sun, and notably of a Turkish bath, seems to confirm this supposition ; but when the skin is suffused with blood to a maximum degree in cases of fever, especially of scarlet fever, perspiration is wholly absent ; and when, as in sea-sickness, there is a minimum amount of blood in the skin and an absence of the normal degree of heat, perspiration is profuse. These apparently contradictory phenomena are, of course, in real harmony with each other, and will no doubt receive a satisfactory explanation ; meanwhile I offer a suggestion which may, perhaps, give some clue to the mystery. I said that the chief function of the sympathetic nervous system consists in the control of the blood-vessels. There is little doubt, however, that the functions of this system are complex, as its structure is. It has been stated that the sympathetic ganglia receive fibres from the cerebro-spinal system, as well as give fibres to it. This instance of structural complexity may be accepted as a suggestion that analogous ones, as yet unknown to us, exist, and in like manner that other functions than those already clearly demonstrated are performed by the sympathetic nervous system. It may be, therefore, that the sweat-glands are under the control of a special set of nerves as distinct in their functions as those presiding over the circulatory system. Their action, however, may be very different. The stimulus of a vaso-motor nerve, as we know, causes the vessel on which it ramifies to contract ; but the stimulus transmitted along the nerves presumed to regulate the action of the sweat-glands may cause them to pour out their secretion in increased abundance.

If so, it is intelligible how it comes to pass that when there is a maximum quantity of blood in the sympathetic nervous centres, induced in cases of sea-sickness, as already explained, perspiration is profuse, although there is a minimum amount of blood in the skin. I am tempted to make this suggestion, because when in treating cases of an inflammatory character, the pulse being high, and the skin hot and dry, I have applied heat along the back, not only has the pulse been reduced, the inflammatory symptoms subdued, and the skin become cool, as I predicted and expected, but, unexpectedly, the patients have also speedily broken out into perspiration. In these cases it is certain that the nervous centres along the back had an unusual amount of blood drawn into them by the heat which had been applied, and that, therefore, they were, physiologically speaking, in the same state as are the nervous centres of persons suffering from sea-sickness, and in both classes perspiration obtains. I have already adverted to the great sympathy or intimate relation between the skin and the mucous membrane of the alimentary canal, indeed there is great analogy between their functions; and bearing on this question of the physiology of sweating, I have observed a fact in respect to the bronchial mucous membrane similar to that which I have just recorded in reference to the skin, and of an equally unexpected character. In treating pulmonary catarrh and bronchitis, I apply heat along the dorsal region, in order, by inducing a præternatural afflux of blood in the thoracic ganglia, to cause the arteries supplying the bronchial mucous membrane to contract. Now, if at the stage of congestion of this membrane, when it is dry, its wonted secretion being absent, heat be applied to the dorsal region, as described, not only will the congestion be lessened, as I expected, but, con-

trary to what I at first expected, a slight secretion of mucus rapidly ensues, to the great relief of the patient. It seems to me that this phenomenon can only be accounted for on some such principle as that suggested to account for the perspiration also induced as described by the application of heat to the back. These suggestions receive considerable countenance from the fact announced by Prof. Claude Bernard—that the salivary glands are not under the control of the sympathetic, but of the lingual nerve, and that their secretion increases in proportion to the amount of positive stimulus received by them from that nerve. It seems to me probable that what I have just said will explain how the sweating, sickness, and diarrhœa of phthisis are induced, and will suggest how it may be lessened or prevented. The sympathetic ganglia are, I believe, brought into a state of hyperæmia by the irritation of the vasic nerves distributed to those blood-vessels in the vicinity of tubercular deposits; and this hyperæmia becomes the proximate cause of the phenomena in question. Of course in such cases the remedial power of ice can be justifiably used only with great judgment and discretion, and with especial care. I may add that the therapeutical results I am about to describe not only confirm the general doctrine now expounded—of the proximate cause of the various phenomena of sea-sickness—but give a peculiar sanction to the view here expressed concerning the physiology of perspiration; for, as I shall show, by lessening the amount of blood in the nervous centres along the back, the perspiration incidental to sea-sickness is completely arrested.

TREATMENT.

The inevitable conclusion from all the facts and

arguments of the preceeding exposition is that the only scientific and really effective remedy for sea-sickness must be one which has the power of lessening the amount of blood in the whole nervous centres along the back. This, as I have proved, can be effectually done by lowering the temperature of the spinal region by the application of ice. A formidable-looking remedy, I admit; but when it is judged of by the aid of experience it ceases to terrify, and, on the contrary, is found decidedly agreeable. Ice applied in bladders or by any of the ordinary methods would undoubtedly occasion great discomfort, would constrain the movements of the patient, compelling him to remain for the most part in one position, and, in fact, could not be so applied as to ensure success. It is necessary, *first*, that the ice be kept in contact with each region of the spine, the upper portion of the ice being prevented from falling down as the melting proceeds; *secondly*, that the application do not extend far on each side of the spinal cord, otherwise the patient will become cold; *thirdly*, that, having regard to the comfort of the patient, the mouth of the bag containing the ice be so effectually closed as to prevent the water from escaping as the ice melts; *fourthly*, that the mouth of the bag be as wide as the bag itself, in order that the bag may be easily and rapidly filled; and, *fifthly*, that, without any inconvenience to the patient, facility should be afforded for giving escape to the air which accumulates in each compartment of the bag as the ice melts.

After long consideration and many experiments I have succeeded in perfecting a bag which fulfils all the above requirements. It is made of india-rubber, and consists of several compartments—generally three. These compartments are separated from each other either

by intervening brass clamps applied externally, or by internal india-rubber septa of different lengths. In all cases the mouth of the bag is closed by a clamp, one side of which is so thin as when turned next the back to cause no inconvenience to the wearer of the bag, while the action of the clamp itself helps to keep the bag in its requisite oval shape. Loops are affixed to the outer side of the bag, by which it is sustained and secured in its place.

When about to apply the bag having internal septa I put ice (broken into pieces about the size of a small walnut) in the opening on the side nearest the loops until the contents of the lowest cell reach up to the bottom of the second cell. I then put ice in the middle opening until it reaches up to the bottom of the third cell, and, finally, having filled the top cell, close the bag with the clamp. *It is of the utmost importance that the bag be filled only in this manner*; otherwise there might in the middle third part of it be two, and in the upper third three, layers of india-rubber between the ice and the patient's back. I take care that each cell is not so filled as to cause it to become round, otherwise only a small portion of the bag will touch the back. A further precaution is necessary: as ice contains a considerable amount of air, this air, as the ice melts, accumulates at the top of the bag, and being a bad conductor of heat, prevents the still unmelted ice which it surrounds from exerting its intended influence; I therefore unscrew the clamp occasionally, and thus let the air escape, and, if the bag is to be worn for a considerable time, replace the air by a little fresh ice.

In order to keep the bag in its position most securely, and at the same time to allow the patient to remain upright or to walk about, I pass an elastic band through

the upper loops of the bag and then round the head. The bag is thus held close to the back of the neck. I then pass a long tape through the lower loop, carrying each half of this tape over the shoulders, crossing one over the other in the front of the chest, carrying them backwards round the waist in order to clasp the bag closely into the small of the back, and finally bring them forward, tying them in front. The bag will thus be sustained chiefly by the shoulders instead of by the head. This method of securing the bag is, however, not essential: it may be sustained in the case of men by buttoning the waistcoat and coat tightly over it; and in the case of women, by tightening their dress over it in like manner. Of course, when stays are worn, it is necessary to loosen them sufficiently to allow the bag to pass down between them and the back. But I know no way of keeping the upper segment of the bag in close apposition with the back of the neck equal to that by means of the elastic band used as described.*

Until ice shall be habitually kept on board passenger-vessels, persons liable to sickness must of course continue to suffer, unless they provide ice for themselves; to do so, except for short passages, would be difficult; but for passages of a few hours only, each passenger may easily supply himself with the requisite quantity of ice. Each bagful when applied to the back melts in about two hours, faster or slower, of course, according to the temperature of the weather. For the passage between Dover and Calais one bagful suffices; one will also suffice between

* The bags, as described in the text, have been patented in England and on the Continent, and may be obtained of C. Macintosh and Co., the manufacturers, 3, Cannon-street West, London; S. Maw and Son, 11, Aldersgate-street, London; John G. Gould, 198, Oxford-street, London; Thos. Chapman, 56, Buchanan-street, Glasgow; and also, by order, of all surgical instrument makers and druggists.

Folkstone and Boulogne, unless in cases of peculiar severity. Between Newhaven and Dieppe three bagfuls are required; between Dover and Ostend two. As the Channel steamers do not yet carry ice, passengers who intend to use it between Dover and Calais, or between Folkstone and Boulogne will save themselves trouble by having a bag properly filled in London, and then packed in a mat or carpet-bag, or any other convenient vehicle, surrounded by an abundance of sawdust or several folds of a thick woollen rug or other woollen material. Shawls, flannel vests, or petticoats, and woollen coats, with which the traveller's carpet-bag may happen to be provided, will answer the purpose quite as well, and, if so used, the only addition to the luggage is the ice-bag with its contents. Thus packed a short time before the train starts from London, it may be conveyed to Dover or Folkstone ready for immediate use, the ice having melted very slightly meanwhile. For passages of several hours, unless two or three ice-bags were taken on board, prepared and packed as above, it is necessary to take a supply of ice packed in plenty of sawdust by the ice-merchant, and an ice-breaker, by which it may be reduced to fragments as wanted. From two to three pounds of ice for every two hours the passage lasts would be the quantity required by an adult.

In the great majority of cases the treatment of seasickness need consist in nothing more than keeping along the centre of the back an ice-bag, constructed, prepared, and sustained as described, and extending throughout the cervical, dorsal, and lumbar regions, or from the top of the neck to the lower part of the hollow of the back. So long as the liability to sickness continues, cold must be applied as directed. The results of seventeen experiments made, chiefly under my direction,

in the treatment of sea-sickness in this manner induce me to believe that, as a general rule liable to few exceptions, the effect of this simple expedient will be the annihilation of all unpleasant symptoms: the sickness will stop; if diarrhoea is present, it will be subdued; if the patient is only threatened with it, the attack will be averted; if there be headache, with coldness of the forehead, the pain will vanish; the cold clammy sweat will cease to be exuded; the cold skin will become warm again; the muscular system will regain its usual strength; the mind will recover its energy and pleasurable interest in surrounding objects; and the sickly pallid features will resume their expressive energy and healthy hue.

Persons differ, however, so greatly from each other in respect to their liability to sea-sickness, in respect to the parts of the nervous system most easily affected, and in respect to the facility with which the circulation may be influenced by cold applied along the back, that many cases of sea-sickness in persons otherwise accounted healthy will demand special study and special treatment. Moreover, in cases of constitutional or local diseases, or even of mere functional disorders, additional knowledge of the physiological action of cold, when applied to the back, on the various parts of the body, and additional care and precautions in prescribing it, will be essentially necessary.

Persons whose liability to sea-sickness is not extreme will, I believe, generally find that the malady may be wholly prevented by applying ice, as directed, as soon as they find themselves becoming ill. In such cases the degree of cold requisite for stopping the sickness will most frequently be obtained if the bag be placed outside the shirt or chemise, and in some cases even outside the flannel vest, when such garment is worn. I

have satisfied myself, however, that *in all cases it is much the best to let the ice-bag come in direct contact with the skin.* The part seemingly most sensitive, and that corresponding physiologically to the stomach and bowels, extends from the lower angles of the shoulder-blades to the lower part of the hollow of the back. It is, therefore, of paramount importance that the lower segments of the ice-bag extend completely over this region and be pressed in close contact with it. If there be headache, and if the forehead be at the same time cold, the upper part of the bag must also be kept in close contact with the back of the neck. If, however, in exceptional cases, while the head aches, the forehead should be hot and the face flushed, the cold applied to the upper region of the spine must either be lessened or wholly withdrawn. It will be found in some cases most desirable merely to modify its intensity by placing a pocket-handkerchief (a silk one is best), folded to the requisite degree of thickness, between the bag and the upper part of the spine. The handkerchief must extend along the whole cervical and the upper third of the dorsal vertebræ, or from the nape of the neck downwards to between the shoulders. Experience will teach those who use ice along the back, that there seems almost as if there were a wonderful intelligence in the nervous centres of the whole spinal region, which denotes by quickly expressive and unmistakeable feeling the exact parts where the application of ice is most desirable, and where it should be omitted. I recommend all who use it to attend to these intimations as trustworthy oracles.

Patients of præternatural sensibility in the spinal region, or who are unusually liable to sea-sickness, ought not only to apply the ice-bag direct to the skin, but also for a considerable time—say half an hour, or an hour even

—before they go on board ship. When the patient is leaving an inland town for the coast with the intention of proceeding direct from the railway carriage on board the vessel, it will be best to apply ice while still in the railway carriage. In many such cases this preliminary application need be made to the lumbar and the lower part of the dorsal region only; but in all such, until the person goes on board, or rather till the movement of the vessel begins, I would urge that the feelings should be consulted, as to whether the ice should be extended along the upper part of the back or not. In these cases of præternatural sensibility, while the patient is on board the ship, should there be any motion and should the tendency to sickness have not completely subsided, it will be necessary that the ice be kept to the back *without the intermission of even a few minutes*, so speedily does the excess of blood recur in the nervous centres while the motion of the ship continues. In order to ensure the unintermitted application of ice, such sensitive patients ought to be provided with two bags, so that one can be replenished with ice and ready for immediate application before the other is removed.

Medical advisers of persons with tender lungs will have to urge upon them the need of taking special precautions in using ice in the manner here indicated. For reasons which I shall shortly mention, they will often be able while on board a ship in motion to bear with impunity ice along the dorsal region, although, if on land, they might not be able to do so. Therefore, unless in very urgent cases, it would be well for them not to apply cold to the dorsal region until on board the ship in actual motion, and then, if they should experience any unpleasant sensation whatever in the chest, they should restrict the application of the ice to the

cervical and lumbar regions only. It will be necessary also to proceed cautiously in applying cold to the lumbar region of pregnant women, and of women during the period of menstruation. I have had as yet no experience in the treatment of such cases of sea-sickness; but as I have demonstrated that ice to the lumbar region will both induce and increase the menstrual flow, and as, from *à priori* considerations, I believe it probable that ice so applied in the case of pregnant women will facilitate abortion, it is expedient, until experience has afforded positive knowledge in this matter, to proceed with great caution; to attend to the sensations of the patient sedulously; and, if the ice be applied to the lumbar region, to remove it immediately any unpleasant feelings are experienced. The same reason, however, which will allow persons with tender lungs to use ice with greater impunity on board ship than they could do on land, will also allow the two last classes of patients to do the same, and hence I anticipate that with the exercise of a due amount of prudence, aided by adequate physiological knowledge, all three classes of patients may, without injury, save themselves from sea-sickness by the remedy in question.

As an ancillary remedy which has often been found useful, I recommend the drinking of iced water, or better, the swallowing of small lumps of ice. Assuming the proximate cause of the malady to be what I have affirmed it to be, it will be seen at once that ice, brought in contact with the peripheral ends of the nerves of the stomach, will act on the same principle as it does when applied to the spinal region: it acts as a sedative, and so far, at least, as the stomach is concerned, lessens the number of irritating impressions which would otherwise

be transmitted from that viscus to the spinal cord, the reflex action of which is thus also lessened.

In concluding these remarks on the treatment of sea-sickness, I may as well anticipate and answer the objections which have arisen, and which will no doubt long continue to arise, in the minds of persons unacquainted either physiologically or experimentally with the remedy in question, not only to its long-continued use, but even to its use at all. Many persons shudder at the idea of having a column of ice placed along the back, and think were it continued there for a moderately short time that the discomfort would be extreme, and more injurious results by its continued use would speedily follow. In answer to the objection, that ice to the back, in order to arrest or prevent sea-sickness, must be so disagreeable as to make the remedy deserving to be characterized as worse than the disease, I shall simply appeal to the experience of patients. In the first place, such is the universally confessed misery of severe sea-sickness, that it is difficult to conceive of any remedy being worse than the disease; but as the application of ice restores to a normal condition those nervous centres on which the healthy circulation and functions of the whole organism depend, it is reasonable to presume *à priori* that the process of this restoration must be agreeable, and, as a matter of fact, it certainly is so. The ship's motions having induced an abnormal amount of blood in both the spinal and the ganglionic centres, there is necessarily a greater evolution of heat there than is usual during health; and hence it is that cold along the whole spinal region is not only tolerable but positively pleasant. Indeed, patients not only find the cold pleasant, but crave that it should be more intense, and their feelings of the comparative agreeableness of

the cold in different parts of the back are a very valuable guide to those particular points where, from constitutional peculiarities, the abnormal afflux of blood in the nervous centres is the greatest, and which, therefore, they instinctively desire should be rendered coldest.

It would undoubtedly be a great blessing to all persons travelling by sea, and who suffer from seasickness, to become possessed of some magical remedy which they might take once for all, and which would permanently charm away their sufferings. But, by an inexorable logic of Nature, results unfortunately, or fortunately, are continuously produced so long as their causes continue to operate. The ultimate cause of seasickness is the unstable sea, and as that cause is likely, with intervals of calm, to be everlasting, so will its result—seasickness—continue in each patient until his organization has adapted itself to live on a moving surface; or unless that result is averted by a remedy as continuously active as the cause itself.

This subversion of those physiological conditions on which the derangement of the viscera constituting seasickness depends, can only be effected by a remedy, the operation of which can be continued as long as those conditions continue to be induced. Sufferers will have to choose between the continuance of their sufferings during uncertain lengths of time, and the slight trouble and inconvenience of wearing an ice-bag along the back, and of having it replenished each time the ice melts. I affirm confidently, however, that when they have once made their election in favour of the ice-bag, they will have no doubts afterwards as to the wisdom of their choice.

The objection to the remedy which possibly, but not probably, may prove really formidable is that, in cases

of long-continued sea-sickness, the long-continued use of ice may prove physically intolerable, as it may induce physiological or pathological conditions in the body of the wearer of a character more injurious and troublesome than sea-sickness itself. I do not, however, expect this result. If ice were worn continuously during many days consecutively by a person on land, it might be productive of grave consequences, the more so, of course, if the wearer were suffering from some constitutional malady which involved an abnormal diminution rather than afflux of blood in the nervous centres along the back. In respect to a person at sea, however, in a vessel moving sufficiently to make him sick, the case is widely different. An undue afflux of blood in the nervous centres along his back is produced by a cause continuously operative, and, therefore, ice applied along his spine does not reduce the amount of blood in those centres below the normal standard, but only prevents it from increasing beyond that standard, and so long as it only does this it can only do good. This being the case, I venture to predict that ice may be applied to the backs of otherwise healthy persons suffering from sea-sickness, so long as they would continue to be sick if it were not thus applied; and that, for the same reason, ice to the dorsal region of persons with tender lungs; and to the lumbar region of pregnant and menstruating women, may also be applied with impunity, seeing that the unusual amount of blood brought into the different regions of the nervous system just mentioned, by the continuous motion of the vessel, operates as a shield against that special influence of the ice which, in their case, might prove injurious were they on land.

SECTION III.

*Experiments illustrative of the Efficacy of Ice,
applied along the Back, in stopping
Sea-Sickness.*

EXPERIMENT I.—Mademoiselle H., who left London at 8:30 p.m., February 19, 1864, and crossed from Dover to Calais the same night, was the first person on whom the experiment of arresting sea-sickness by the application of ice to the back was tried. I had previously crossed the Channel with her more than once, and can testify that I have never seen a person suffer more terribly from sea-sickness. Indeed, her suffering is usually so excessive, and it exerts such a depressing effect upon her, that after leaving the vessel she continues ill for many hours.

When she left London, at the date mentioned, I supplied her with an ice-bag of suitable length properly filled with ice. This bag I packed in a small mat-bag and carefully surrounded each part of it with sawdust, in order to prevent the ice from melting. Thus prepared, the ice-bag was ready for immediate use. The following is the lady's report of its effects:—

“Hotel de Lille et d’Albion, Paris,

“Feb. 21, 1864.

“DEAR DOCTOR,

“The experiment, though sadly managed, has been crowned with the *utmost success*. The train was so late that when it arrived at Dover, we were literally thrown into omnibuses and cabs, and reached the ship just a

minute before she started, and I found only the time to undo your rather too-well packed pareel, and to ask a stupid boy of a steward to push the bag down my back. Of course he could not manage it, and nobody else being there, I was left to myself to arrange it as well as I could. After a little time I felt that my flannel habit-shirt was under the ice-bag, which I wished to be near the skin and a little lower down, as the boy had scarcely brought it to the middle of the back. The sea was very rough, and I feared much movement might make me sick. In these struggles the india-rubber in the lowest division gave way, and only a quarter of an hour after we started a hole was made, which allowed the melted ice to pour down my back. You can imagine what a pleasant feeling this perpetual stream was during a cold night.* I shivered violently,† but feeling otherwise quite well kept the bag convulsively to my back, keeping the part to which the elasp is attached round my throat.‡ I think nearly every one was sick, and I, the usually most of all, not only not sick, but even well, feeling as if I were in a cradle, being rocked by the gentle hands of a tender nurse. The longer I remained in this state the more inclined I was to think, ‘Oh! I shall soon be

* It snowed at the time she started from the Victoria Station, and probably continued to do so while she was on board the boat.

† It is right to observe that she is apt to shiver on the smallest provocation, even in summer; on this occasion, however, as she was on the deck of a vessel in a snowy night, with melted ice running down her back, her shivering was certainly not to be wondered at; but had the bag not burst, the *dry* cold to her back would have helped to warm her. During the very coldest days of last winter a paralytic patient, whom I was treating at Guy’s Hospital, was the only one walking about the grounds on several occasions when I visited the hospital: he had a column of ice on his back! The other patients shrank from the cold, and while those in the ward with him huddled round the fire, he had no wish to go near it.

‡ The elastic band in question ought to have been passed round the head, the front part of it crossing the upper part of the forehead in the same way as the velvet head-bands, fashionable some years ago, were worn.

sick; this can't last.' But wonder over wonder, we reached Calais, and I had not experienced even the slightest nausea; though I feared the wet clothes would give me a cold, which they have done. You know what a bad case I am; you have seen the state in which I have been when crossing the Channel; and you will be able to judge what a much better effect will be produced when the bag is *sound*, and when the whole is *properly managed*; but even under the trying circumstances the success has been complete, and I may venture now to go to America, provided the ship has an ice-room to give a fresh supply when the old is melted. I don't know, of course, the effect of ice on a long continued voyage, but I venture to believe that the feeling of perfect comfort would continue as long as the ice is kept on. I had eaten very little in the day, and my stomach began to feel empty on the sea, so that I could have eaten. You know when we arrived at Calais I never was able to touch anything; I took this time a cup of beef-tea with great delight. Of course you must have further evidence to state this, to my mind, most important discovery as a positive fact. Yet fancy me *hearing* them vomiting violently, and I *feeling well* all the time. I am quite ready to give any evidence, or report to whomsoever you will direct to me."

The desire for food which Mademoiselle H. says she felt while still on board the boat, seems to be far from unusual in persons with ice on the back while at sea, and who without it would be sick. It will be seen that Mrs. H., in Experiment II., longed for a beefsteak; and that in Experiment X., after I had been cured, I ate heartily of biscuits and cheese and drank a bottle of ale, my appetite-giver being kept close to my back meanwhile.

EXPERIMENT II.—Mrs. H. This lady usually suffers extremely when at sea from sickness and intense headache, and on two occasions had a series of epileptic fits, induced also by the ship's motion. She suffered in this way while passing from Boulogne to Folkstone in May, 1863, and previously while going from Rhyl to Liverpool, when after being taken out of the vessel she was, as stated in her letter, regarded as at "the point of death" by her medical attendants.* During this passage she had a succession of fits lasting the whole time. Although she has only lost her consciousness during these two passages, she generally suffers from 'tonic' spasms in various parts of the body, especially in her limbs, which become rigid. She is also liable to violent and frequent attacks of hæmoptysis. So slight is the motion needed to make her sick, that she is often made so merely by travelling in a railway carriage.

She came under my care in June, 1863, on account of her epileptic attacks, which, although formerly frequent, now rarely occur. Thoroughly impressed with the efficacy of the treatment, chiefly by means of ice, adopted in her case, and feeling assured that if by the same means she could be saved from sea-sickness, the remedy might be justly regarded as established, she consented not only to have ice applied to her back each time she crossed the Channel in going from London to Paris and back, but also, in the interests of science, to make a special trip between Folkstone and Boulogne. I accompanied her on each occasion. During the first

* That she was in a state seemingly justifying their opinion, I can readily believe. I have since seen her in a like state, and believed that life had become extinct. The surface of the body became cold, her face pallid, her head fell forward while I sustained her body in a sitting position; I could detect neither pulsation of the radial artery, nor any sign of respiration, and expressed to her sister, who was present, my fear that all was over.

passage a friend of hers crossed with us : the experiment he made is described under Number VII. The following is a report of her experience :—

May 12th, 1864. We left London by the tidal train for Boulogne. While in the train Mrs. H. had headache and felt sick. As soon as we reached Folkstone, and before going on board the steamer, I applied an ice-bag to her back ; it extended along the lumbar, dorsal, and the lower half of the cervical region, and was outside her thin dress. She wore no stays. She remarked that the sensation caused by the cold was very agreeable. The steamer left Folkstone at 1 p.m. The day was clear, warm, and fine ; there was a tolerably fresh breeze, but the sea was so far smooth that only three of the passengers, whom I observed, vomited.* I did not feel the least nausea.

Soon after the steamer started Mrs. H.'s head became hot and very painful, and her cheeks flushed. She said her headache was of a kind peculiarly intense (a sense of extreme pressure), and never felt by her except when at sea. I therefore placed a silk handkerchief between her neck and the bag, extending it downwards between the shoulders. Her head then became gradually better, and before long quite clear and free from pain.

She felt the cold to the back peculiarly grateful, but wished it more intense ; the bag was therefore placed next her skin. This change delighted her ; but she said the bag did not extend low enough down. I then applied a second bag in the lumbar region outside her dress ;

* I exerted all the persuasive power I could to induce them to let me cool down their dorsal nervous centres ; but the resolute incredulity with which my promises of relief were listened to, and my proposals to supply ice and ice-bags at my own expense were rejected, evinced but too plainly their conviction that I was suffering from a malady which entitled me to board and residence free of expense at Colney Hatch.

this addition was felt to be a great improvement. Before the bag was placed next the skin she felt fearful she should be sick, but afterwards this fear soon passed away, and she reached Boulogne without any sign of sickness.

At one part of the passage she said, "There is a strange contest going on within me, one force against another: the body seems to say 'I will be sick,' the ice; 'But you shan't.'" She afterwards informed me that she apprehended an attack of diarrhœa, as she had all the feelings usually preluding it, and even feared she should be forced to the cabin "for ladies only;" but, thanks to the ice, this dread vanished beneath its influence, as well as every feeling which induced it.

Ordinarily she could not have borne the ice two hours without becoming ill; but during the passage she thoroughly enjoyed it, and craved for it still colder. After the ice had been placed next the skin, she felt so well that she wanted a beefsteak on board the boat. She bore the whole journey to Paris immediately afterwards remarkably well, eating a hearty dinner at Amiens. Being, however, without ice, which, applied to her back, would have prevented the sickness caused by her travelling by rail, she felt sick before reaching Paris, and threw up her dinner on arriving at the station.

After reaching Paris she wrote me the following letter:—

"Hotel de Londres, 5, Rue de Castiglione,

"Paris, 14 May, 1864.

"DEAR DOCTOR,

"At your request I write you my impression of the value of the experiment, made on the 12th instant, in order to test in my case the power of ice in preventing sea-sickness.

“Merely to say that I crossed the Channel without being sick and without feeling nausea, and that I ascribe this fact to the ice applied to my back during the passage, would in no sense convey to you my estimate of the value of your discovery. You must know what a victim I have been on all previous occasions when on the sea before you can understand the inexpressible relief I now feel in thinking of having to cross the Channel or to make a sea-voyage.

“In the first place, I so easily become sick that I often am made so by the movement of a railway carriage. Previous to my passage from Folkstone to Boulogne on the 12th instant, I had crossed the English Channel fourteen times, and the Irish Channel twice. I have been to the Isle of Man, and I have been in steamers between Liverpool and various parts of the Welsh coast at least two hundred different times. On all these occasions, excepting three or four, I suffered fearfully from sickness; during the three or four times when I escaped sickness the sea was as smooth as glass, but even then, after I got on shore, I either vomited or was ill. I am so prostrated by the effect of the movement, that on two occasions it has been necessary, when the vessel arrived in port, to carry me on shore. Once in Liverpool I was so deadly cold and stiff that it was deemed expedient to put me in a warm bath, just as I was taken out of the vessel, without removing my clothes, and the two physicians attending me expressed their belief that I was on the point of death. On this occasion I was a prisoner in the hotel, confined to bed six days, and even when sufficiently recovered to leave the hotel I was obliged to be carried from my room to the carriage in which I left. This is the only time when I have suffered so severely,

but on almost every occasion I was ill several days after landing from the vessel.

“You will now be able to form some idea of the horror with which I have always contemplated the prospect of a sea-passage, and of the unspeakable blessing which your discovery has conferred on me as on all who suffer like me. Indeed, such have been my usual feelings about crossing the Channel, that even when I had reached the French shore, saved from all suffering, it seemed almost impossible for me to realize the fact, and I could not help relapsing unconsciously from time to time into the old feeling of terror at what I had still to suffer.”

EXPERIMENT III.—May 22, 1864. Mrs. H. crossed from Boulogne to Folkstone. The day was fine, the sea smooth, and the motion of the vessel very slight, but still sufficient to make her speedily sick. Before leaving Boulogne she lay on an ice-bag nearly two hours, and then went on board the steamer without the bag, which was not applied during the passage. She crossed the Channel without feeling any nausea ; but just before reaching Folkstone she suddenly vomited once, without, however, previously feeling ill or any of the usual retching or muscular effort which causes so much suffering.

This experiment is interesting as an indication that, if before a person starts in a vessel, the excito-motor power of the spinal cord be reduced by the application of ice to the back, sickness may be averted, or its vehemence lessened for some time after the vessel has put to sea. This fact received some confirmation from the experiment next recorded.

EXPERIMENT IV.—At 10.30 P.M. of the same day, Mrs. H. left Folkstone for Boulogne. It was a

clear, starlight night, and the sea was about as smooth as it had been during the previous passage. No ice was applied to her back either immediately before (as in the former case) or when leaving, but she lay down as soon as she got on board.

In about ten minutes after the vessel started she became violently sick, the muscular effort being so extreme as to cause her to say—"Oh, doctor, I think my heart is coming up!" I applied ice along the entire spine as quickly as possible, when she was *instantaneously* relieved, and then lay down upon the ice soothed and calm, though still feeling nausea. In the course of about fifteen minutes she again suddenly threw up some fluid, but without any evidence of muscular effort, retching, or distress. In about fifteen minutes more she did the same, the stomach alone seeming as before to contract for the expulsion of the fluid without any aid from the thoracic and abdominal muscles. She then lay still a long time on the ice without sickness, but without entirely losing the feeling of nausea. A fog came on, and as much caution was needed in trying to find Boulogne harbour, we did not reach it till 3 A.M. She afterwards went on deck, the ice being still applied to her back, and though there was quite sufficient movement to have kept her sick under ordinary circumstances, she lost her sense of nausea, walked about, and, notwithstanding the fatigue of a four-and-a-half hours' passage and her loss of sleep, felt quite well and very hungry on reaching the hotel at Boulogne. Having slept till a late hour in the morning, she rose as well as usual.

EXPERIMENT V.—This was made under peculiarly unfavourable circumstances. Mrs. H. had been very ill in Paris during the previous few days, had mental troubles,

some cerebral disturbance in consequence, and June 13th a considerable attack of pulmonary hæmorrhage. Nevertheless, she felt it necessary to come to London. I was provided with a free pass between London and Dieppe by the Brighton Railway Company in order to facilitate my experiments; and having taken my daughter over the Channel by that route on our way to Paris, I had again an opportunity of re-crossing the Channel with Mrs. H., who, relying on the ice, resolved to encounter the long passage between Dieppe and Newhaven. On account of her recent sufferings and hæmoptysis and her consequently enfeebled state, I felt of course some considerable apprehensions as to the possible effects upon her of a sea-passage lasting several hours, if she did not use ice, and was almost equally fearful of using it lest it should bring on a fresh attack of hæmoptysis. However, for the reasons already given, I considered that the danger of applying ice in such a case is greatly lessened while the patient is sea-sick or has a tendency to become so, and its application was determined on as the lesser of the two evils, one of which must be chosen.

I filled seven ice-bags with ice in Paris, enclosed them in a bagful of sawdust, and thus prepared, we left for Dieppe in the evening of June 14th, and at 3 A.M. June 15, 1864, we started from Dieppe to Newhaven. Deprived of her night's sleep, and having had very little rest between leaving the train and going on board the boat, Mrs. H. was of course in the least favourable condition for bearing the passage she was about to enter on.

It was fully resolved that ice should be applied before the vessel started; but in Dieppe harbour there was such a perfect calm that we were quite confident the sea would

be smooth; the sailors were of the same opinion; and consequently the ice was not applied as intended. Not many seconds, however, after the vessel had got clear out of the harbour, we became painfully sensible that there was a strong head-wind; the vessel began to pitch; the water to dash over her, and soon there was only one part of the whole deck, and that only two or three square yards, which was not continually washed by the violent spray. Both funnels were white with long lines and layers of salt deposited upon the hot iron from the sea-water which was copiously dashed against them and rapidly evaporated. Only one passenger besides myself remained on the quarter-deck—a Frenchman, who, standing on a seat, lashed himself to the shrouds, and there, bolt upright, gazed steadfastly to windward, being drenched incessantly meanwhile from head to foot by the spray!

Immediately the motion of the vessel began, Mrs. H. began to be ill. We were on deck at the time, and as the ice-bags were in the cabin there was necessarily a slight delay in getting them. During that short time she became rapidly worse. She complained of an indescribably intense headache; her face was extremely flushed; she retched most violently; vomited several times;* and the muscles of her limbs became rigid. We both feared that an epileptic fit was inevitable. However, notwithstanding her constant straining and partial rigidity, I succeeded in applying cold along the upper part of the back, and thus at once averted the fit and arrested the extreme retching and straining which so distressed her. Unfortunately the demon of sea-sickness had already got such hold of her that, her bowels becoming

* The vomited matter consisted partly of the food which she had eaten for breakfast the day before! Of course, such being the case, she was strongly predisposed to be sick.

affected, she was forced immediately to leave the deck and go down to the cabin "for ladies only." Afterwards she lay on a sofa in the ladies' cabin. I ventured to *look* in at intervals; but though all the inmates were prostrate, several of them vomiting, and though I pleaded for admission in my professional capacity, the stewardess, faithful to Mrs. Grundy, sternly refused to allow me to go near my patient. I tried to induce the said devotee to apply the ice for me as I should direct, but having an opinion of her own that it would only increase my patient's sufferings, and resolved that what she evidently deemed my insanity should not be gratified in that way, she not only obstinately refused, but tried to use her official authority to force Mrs. H. to cease applying the ice as best she could for herself. Weak and ill as she was she could not manage to get the bag down within her dress to the hollow of her back, and so was fain to lie on it outside her dress in the lumbar region. When the ice was melted, the inexorable stewardess stoutly refused to fetch a fresh bag, and only when at length addressed in a very "imperative mood" indeed did she reluctantly obey.

I ventured occasionally to look at my patient from the doorway of the cabin sacred to womankind: I once saw her vomiting, and on each other occasion lying down seemingly asleep. When we neared Newhaven, she rose, arranged her dress, and walked ashore, wonderfully little pulled down compared with what I anticipated, took a cup of tea at Newhaven, and bore the journey to London immediately afterwards very well indeed. She had experienced no trace of hæmoptysis, no dyspnœa, and no feeling whatever of pulmonary congestion—symptoms which on land she had often experienced. She said that, notwithstanding the partial and unsatisfactory way in which the ice had been applied, and though she

had often vomited and felt constant nausea, she had slept several times, that the contents of the stomach came up without effort, that she was saved all the dreadful straining so common in sea-sickness, and that she had remained wholly free from muscular rigidity or cramp in every part of her body. This last fact alone, she said, was of unspeakable importance to her; but she was confident that she might have been saved from sickness altogether if the ice had been properly applied next her skin some time before going on board and throughout the passage. The result of the next experiment seems to justify this opinion.

EXPERIMENT VI.—July 26, 1864. Mrs. H., accompanied by myself, left London to cross the Channel from Folkstone to Boulogne. When about half-way between London and Folkstone, a short bag of ice was applied along the lumbar and lower dorsal region, and just before the train reached Folkstone a long bag was applied next the skin, over the lumbar, dorsal, and lower cervical regions. Having the bag thus applied, she went on board the steamer. She was neither sick nor felt nausea in the train.

There was a brisk breeze, and the motion of the vessel was very considerable: many passengers on deck, and many more in the cabins, were sick. Mrs. H. sat on deck quite tranquil, engaged in conversation, and reached Boulogne not only without being sick, but without feeling the slightest nausea. The remembrance, however, of her terrible sufferings when formerly at sea filled her with fear lest she should again be ill, and as she got nearer and nearer the French coast, she exclaimed several times, "Well, it's astonishing, incredible!"

At one part of the passage she said—"Doctor, I don't know whether you have ever noticed that one of the first

symptoms of sea-sickness is coldness of the feet and legs ; do you know mine are becoming cold ?” I reminded her that she was making a footstool of the carpet-bag containing the ice-bags filled with ice, and immediately removed it. She soon ceased to complain of cold feet, and had no other unpleasant symptom. About twenty minutes before reaching Boulogne the ice in the bag used was so nearly melted as to cause her to feel that the refreshing and sustaining influence of the cold was lessening ; I therefore placed an additional bagful of ice outside her dress and over the bag already supplied ; this sufficed to restore the agreeable sensations she had hitherto enjoyed, and to continue them till she landed at Boulogne.

EXPERIMENT VII.—May 12, 1864. A friend of Mrs. H.’s, Mr. A., who accompanied us from Folkstone to Boulogne at this date, as already stated, felt decidedly sick, and looked so, but did not vomit ; I therefore urged him not to avail himself of the ice until he should become actually sick, as I was anxious to have indubitable evidence of his sickness, and the opportunity of testing the power of the ice to arrest it after it had begun. Being one of my patients, and having benefited greatly from the use of ice, he knew its value, and therefore, feeling so unwell, was unwilling to wait as I begged him to do until he should actually vomit before using it. Left to take charge of Mrs. H. while I went to another part of the vessel, he helped himself to a bag of ice in my absence. The change which it speedily wrought in him was astonishing : he quickly looked and felt as well and as fresh as possible again.

EXPERIMENT VIII.—Mr. L. came from Aberdeen to

London by steamer to place himself under my professional care. He suffered much from sea-sickness during the passage. I acquainted him with my method of treating sea-sickness, hoping that on his return he would test its value. He was called home very suddenly, and therefore I had no opportunity of taking care that he should be properly supplied with ice for the experiment. Unfortunately he took, as it seems, only one bag of ice, but so far as the experiment went, the result, as reported in the following extract from a letter which he wrote me, May 24, 1864, is satisfactory:—"I filled the bag with ice before sailing, and put it on in the evening. I did not feel squeamish while it was on, but suffered a good deal afterwards, as the ship rolled very much. I had not ice to fill the bag a second time."

EXPERIMENT IX.—Mdlle. G. has been six times at sea, viz., from Marseilles to Civita Vecchia, and back; from Ostend to Dover and back; and from Dieppe to Newhaven, and back. On each occasion, except the last, when ice was used, she suffered much from sickness. After reaching Civita Vecchia, having been sick during the whole passage, she continued ill during three or four days from the effects of the motion at sea. On returning from Civita Vecchia the sea was calmer than when she crossed on the 27th ult., the occasion about to be described; but after being on board the steamer about three hours she became ill and sick, and continued so during the rest of the passage. During the other passages mentioned she was ill nearly all the time, the head being especially affected.

On the 27th of May, 1864, she left London for Paris, and crossed the Channel viâ Newhaven and Dieppe. She took with her four ice-bags, which were filled in

London and packed in sawdust. She was thus saved the trouble of breaking up the ice and replenishing the bag on board the steamer. As the ice in one bag melted, she replaced it by another. She applied the first bag as soon as the steamer started, and kept ice applied during the whole passage. The bag was not, however, placed next the skin, but over a thin dress and the chemise, along the dorsal region; and over the chemise only in the lumbar region. During the first two hours she was quite well in all respects; during the second two hours she was fast asleep—lying on the ice; at a certain period during the third two hours she felt “a little headache and the stomach heavy.” At this time she found the ice in the bag then applied to the back all melted; she applied a fresh bag, when soon these unpleasant symptoms vanished and she reached Dieppe without experiencing the least sickness. She is quite sure, she says, that had it not been for the ice she would have become thoroughly ill. She was particularly impressed with the relief afforded her by the ice, from the great suffering in the head which she had always experienced before when at sea.

EXPERIMENT X.—June 11, 1864. I crossed from Newhaven to Dieppe. The day was fine; there was a fresh but not strong breeze, and just sufficient motion to cause about a dozen persons to become sick. Mrs. G., a young Frenchwoman, began to be very ill soon after the vessel left; she vomited bile frequently, was exceedingly pale, and complained of an intense headache. With much difficulty she was persuaded to allow me to apply ice to her back after her sickness had increased. In the first instance it was imperfectly applied—her dress being too tight to

permit the bag to pass down to the lumbar region. Extending too high upwards in consequence, it came against the head and could not be closely applied to the back of the neck. While the bag was thus applied she sat on deck. She felt some benefit from the application, and at length went down to the cabin, where the bag was properly applied. Meanwhile she vomited two or three times. But after having the ice along the whole spine, and lying upon it, both her sickness and headache ceased entirely, and she became well, talking freely and cheerfully. After the bag of ice was melted she began once more to feel ill; a second bag was then applied, when she speedily became quite well again, and reached Dieppe continuing so.

EXPERIMENT XI.—June 11, 1864. Miss C., a young lady, aged about twenty-one, finding Mrs. G. had been thus relieved, asked to have the benefit of the ice. She was lying down very sick, and complained especially of an acute headache. She was laid on a bag of ice—the bag being next the skin. Her head became quite free of pain in a few minutes; after her head had become well and she had had the ice on about ten or fifteen minutes, she vomited once more, and then, still lying on the ice, fell asleep. In about half an hour she awoke quite well and continued so thenceforward. She rose to dress a considerable time before reaching Dieppe, and though she dispensed with the ice-bag a full half hour before arriving, its imparted virtue sufficed to keep her well meanwhile.

EXPERIMENT XII.—June 11, 1864. During the first forty-five minutes of the passage I felt fairly well, but then broke out in a cold sweat all over, became extremely pallid, felt sick, very uncomfortable in the bowels, and

inclined to be purged. I was so ill that, though I had come expressly to treat persons sick, and though I saw a lady opposite to me suffering severely, I became indifferent and powerless to help her. Having put on an ice-bag, I continued to feel ill about fifteen or twenty minutes, and then rapidly recovered: all nausea, sweatings, and chilliness ceased, the colour returned to my face, as observed by the captain and some of the passengers, the troublesome threats of diarrhœa and uncomfortable sensations in the bowels passed away, and I continued quite well—really enjoying the remaining five hours of the passage to Dieppe. I wore the ice nearly the whole of the time. Soon after becoming well I felt hungry, and heartily relished a lunch of biscuits and cheese with pale ale.

EXPERIMENT XIII.—June 15, 1864. I crossed from Dieppe to Newhaven, having the care of Mrs. H., as already mentioned. The state of the weather during the passage is described in the account of her experience at that date. Her sudden and serious illness so occupied my attention that I was obliged for some time after the vessel started to disregard my own symptoms. I soon began, however, to feel very ill; my skin became cold and covered with a clammy sweat, and my face pallid; I felt nausea, threatenings of diarrhœa, and the wretched prostration, physical and mental, which usually accompanies sea-sickness. After Mrs. H. left the deck for the ladies' cabin, and was thus beyond the reach of my care, I caused an ice-bag to be slipped down my back over my shirt and beneath my waistcoat, buttoned the latter and my coat over it, and pressed it against my back either by leaning against the bulwark as I sat, or by lying upon it. In a short time I felt very much better.

But the continually over-dashing spray, which would not leave any of the after-deck completely free from its invasions, kept my feet and legs wet and cold, and thus induced me on one occasion, when I went below to learn how it fared with Mrs. H., to lay myself down in the only available berth in the cabin. The distance between my face as I lay and the deck above me was so slight as to add considerably to my feeling that the air of the cabin was very unpleasantly suffused with the products of respiration, and that, notwithstanding the improvement which the ice had effected in me, I was becoming worse again. I therefore returned on deck; immediately afterwards I suddenly vomited once, but slightly and without any violent muscular effort, and the symptoms of diarrhœa having returned took on one occasion an active form. I resumed my former position on the driest part of the deck, pressing the bag against my back as before; and the rising sun giving a little warmth to my feet doubtless contributed to my restoration. The cold sweat and nausea ceased entirely; my skin became warm; the bowels no longer felt uncomfortable; my physical strength returned; my mind became quite clear and active; and thus I lay on the ice until we reached Newhaven, watching the fleeting clouds and musing over the revolution in the treatment of a very large number of diseases which will probably take place when the power of influencing the circulation of the blood in all parts of the body by raising or lowering the temperature of the nervous centres along the back shall be generally known and understood.

EXPERIMENT XIV.—May 23, 1864. I went by the tidal train from Boulogne to Paris. In the compartment of the carriage in which I rode was a gentleman

who complained of being far from well. In the course of conversation, finding that he was talking to a physician, he told me that some months previously, in consequence of his wife's serious illness, he had taken her to Italy, that urgent business matters compelled him to leave her there and to return to England; that her continued illness during his absence for several months, had caused him such anxiety, and had so preyed upon him as seriously to impair his health; that he had lost his appetite, and suffered habitually from a sense of nausea; and that as he had just crossed the Channel (*en route* to join his wife), this nausea was now increased, and that altogether he felt very uncomfortable. I said to him, "Well, sir, if you will allow me to prescribe for you, and to dispense my own prescription forthwith, I will undertake to free you from the nausea from which you are suffering." Having obtained a few preliminary explanations as to the nature of the medicine to be prescribed and its *modus operandi*, he assented. I then took from within the ample folds of a Scotch plaid an ice-bag filled with ice, and placed it along the whole length of his back, and requested him to wrap himself well up, and to press the bag closely to him. He said he felt the cold agreeable and refreshing; in a few minutes he said he felt better; before long he expressed his astonishment at finding all uncomfortable sensations, together with the nausea, wholly gone. He kept the bag on his back until the ice had melted and the water had become warm; said he had never felt so well for a long time, and begged to be allowed, if possible, to possess himself of the ice-bag, in order to continue availing himself of the virtue derivable from it. Having obtained my assent, he promised to write to me a report of his further experience in using the bag:

but up to the present time this promise remains unfulfilled.

EXPERIMENT XV.—The following report is an extract from a letter, dated Harwich, July 18, 1864, and addressed to me by my son:—

“You will be surprised to hear of me iceing any one, but I met a gentleman, Mr. B., on the pier the other day, and began to talk to him. I found he was going to start that night by boat, and was in a state of fear about sickness. I recommended him to apply ice, telling him how to do so. He said he would, and that as he was only going for a few days he would call and see me on his way back to tell me the result. He called to-day, and said that he put the ice on his *wife's* back after she had become sick, that she got better in about fifteen or twenty minutes, that he then took it off, and that *there was no return* of the sickness. He said the lady is always sick at sea even in calm weather, fears the sea so much as to be in a fright the whole time, and that this time she was not frightened at all after the ice had been applied. I should add that it was almost calm, but there was a little swell from the wind of the day before.”

EXPERIMENT XVI.—July 27th, 1864. In a letter of this date, addressed to me from Harwich, by Mrs. Chapman, occurs the following report:—

“I am glad to tell you that I have had an opportunity of testing your remedy for sickness, though not in my own person. Some people who are lodging in the same house with us had some friends to visit them, who came by the steamer from London. The landlady told me that the poor lady had been ill ever since she

came ; and late in the evening I heard a noise as if some one was very sick. I rapped at the door of my neighbour's sitting-room, and in answer to my inquiries, found that the lady had begun to be sick while on board, and had continued so ever since : she was also much purged. Her husband, who was with her, was becoming alarmed. I showed him my ice-bag, and explained to him the nature of the remedy. He soon procured some ice, and I filled the bag ; we got the lady to bed, and then put the bag on.

“I went to her in ten minutes and found her shivering. The weather being very hot they had taken the blankets off, and she had only a thin counterpane over her ; they had given her some brandy and water, and that had caused her to be sick again. I covered her up with blankets, and she soon became warm and fell asleep with the ice on her back ; this was about 10 o'clock. She had kept nothing on her stomach all day, so I said that she would probably awake hungry ; accordingly she awoke at 4 o'clock very hungry and quite well ; she ate a crust of bread and had a little brandy and water, and slept again. The next morning she said she felt quite strong and well. She said she was rather subject to what she called bilious attacks, which generally left her weak and with headache for some days ; but upon this occasion, when her illness had been so much more severe than usual, she had no headache and felt quite well. Her friends were full of expressions of gratitude, and attributed the cure entirely to the wonderful bag.”

EXPERIMENT XVII.—Sept. 10, 1864. A friend of mine, a Russian gentleman, who crossed from Dover to Ostend on his way to St. Petersburg, has sent me a

report of his experiments during the passage. The following is a translation of his letter:—

“The sea was calm; I was, therefore, greatly disappointed; you know why: because I had but one victim—an Italian lady, with her husband. I was not sick, but suffered from headache. I applied the ice, which did me a great deal of good. The lady was very ill, just on the point of vomiting. Having two ice-bags filled with ice, I asked her husband to ask her if she would consent to have one of them applied, and, in order to encourage her, showed her that I had one on my own back. She consented. She was so delighted, poor creature, she thanked me a thousand times. The ice made her quite well, and she went to sleep with it on her back. On awaking, she begged her husband to buy a bag for her like the one which I lent her. Afterwards, when the water of the melted ice had become warm, she began to be ill again, and was extremely vexed because there was no more ice. I gave her your address, but I did not part with the bag.”

It is obvious that much more experience than is recorded in the foregoing reports is requisite before our knowledge of the power of ice in stopping sea-sickness, and of all the essential particulars of treatment can become complete. As travellers will now begin, I presume, to try upon themselves the efficacy of the remedy in question, I venture to express a hope that many of them will favour me with reports of their experiments.

The chief points most especially needing further elucidation seem to me the following:—

1. What is the relative sensibility of the different segments of the nervous centres along the back to those impressions caused by the ship's motion, and which

result in sea-sickness? In other words, supposing that, by way of treatment, ice be applied along one part of the spine only, will it prove most effective if applied to the cervical region, or to the dorsal region, or to the lumbar region? [I believe that the region of utmost sensibility will be found to differ in different persons; that in those who, suffering chiefly in the head, experience no functional derangement of the intestines, the most sensitive region will be in the upper part of the back; and that in those who are troubled with diarrhoea, the lower part is most impressionable.]

2. In cases of persons peculiarly liable to sea-sickness, what length of time is it desirable to apply ice along the back, in order to prevent sickness, *before* they expose themselves to a ship's movements? [My experience leads me to think that in ordinary cases a preliminary application during twenty minutes will suffice.]

3. Whether, in cases when the tendency to sickness is prolonged over several days, the "tolerance" of ice along the back continues equally long, so that its power of preventing the threatened sickness may be continuously exercised with impunity as long as the tendency to sickness exists.

4. Whether, in cases of extraordinarily prolonged tendency to sickness, the *tendency* itself is shortened by the soothing influence of the ice.

5. Whether the "tolerance" of ice along the back ceases in any case before the sickness is permanently subdued.